Approval and Communication of Refinery, Maintenance, or Engineering Instructions

Document No.: RI-621	**Title:** On-Line Leak Repair/Leak Seal	**Current Date:** 2/2012
Action: ☐ New ☒ Revision ☐ Cancellation		**Next Revision Due:** 2/2015
Responsible Organization: Maintenance & Reliability	**Position to Contact With Questions/Suggestions:** Materials Engineer	

Summarize Rewritten Material: **Review:** **Minor** ☐ **Complete** ☒

Low Risk Utility Service Definition added and applied to allow for designee approval in lieu of ABUM approval to authorize work for repair.

Engineered Composite Line Wraps and ASME code interpretations of leak seals integrated in the General Rules Section and Repair Types.

Integrated Leak Seal Repair Methodology which IMPACT uses to address leak seals for turnarounds. Refer to General Rules Section and Repair Types. This includes an extra flowchart in Appendix V.

REQUIRED COMMUNICATION/TRAINING

If Type 2 or Type 3 training is necessary – Instruction Owner is responsible for developing the training material and must work with Development Department Manager and Managers of affected personnel to coordinate training of affected personnel and documentation of training.

This document should be reviewed by:	**Type 1 Simple Change**	**Type 2 On-The-Job Training**	**Type 3 Classroom Training**
All Refinery Personnel	☐	☐	☐
Operations	☒	☐	☐
Maintenance & Reliability	☒	☐	☐
Technical	☒	☐	☐
HES	☐	☐	☐
Other:	☐	☐	☐

Necessary Approval for Instructions:

- Refinery Instructions: ***Standard RI approvals have been check marked***
- Safe Work Practices: Development, Operations, Maintenance & Reliability, HES, and Refinery Manager
- Emergency Plans (400 Series RIs): Development, Operations, Maintenance & Reliability, HES, and Refinery Manager
- Engineering Instructions: Technical and HES Manager
- Maintenance Instructions: Maintenance & Reliability and HES Manager
- Cancellation of Instruction: Owner and Refinery or Appropriate Dept. Manager

APPROVALS

☒	**Instruction Owner:** Praneil Prasad	☒	**Development Manager:** *(first signature before final routing)* Rick Smith
☒	**Operations Manager:** Bruce Chinn	☐	**Technical Services Manager:**
☒	**HES Manager:** Dave Feiglstok	☒	**Maintenance & Reliability Manager:** Jay Peterson
☒	**Refinery Manager:** *(final signature)* Nigel Hearne	☐	**Other Manager:**

On Completion – Instruction Owner will send file and message to IPC to post on the Refinery server.

RICHMOND REFINERY INSTRUCTIONS

EQUIPMENT INSPECTIONS, MAINTENANCE, PROCEDURES

ON-LINE LEAK REPAIR/LEAK SEAL

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RICHMOND REFINERY INSTRUCTIONS

EQUIPMENT INSPECTIONS, MAINTENANCE, PROCEDURES

ON-LINE LEAK REPAIR/LEAK SEAL

1.0 SCOPE

This Instruction covers the methods to be used and precautions to be taken by Company forces and/or Contractors during on-line repair of leaks in utility and process systems at the Richmond Refinery. Safety, special precautions, and engineering considerations for leak seal repair work are summarized in Section 3.0. All groups involved must familiarize themselves with this Instruction and comply with applicable procedures and responsibilities.

2.0 DEFINITIONS

*2.1 On-line repairs: Any repairs made to a system while the system is still in service as indicated by retaining stock and/or retaining positive pressure.

*2.2 Single Stud Replacement: Removal and subsequent replacement of a single stud or bolt on a flange, bonnet, etc. No more than one stud may be removed at one time (Reference RI-9900, Appendix C Section 1.5 "Hot bolting or Single Stud Replacement").

*2.3 Appliances: Pressure containment hardware such as standard pipe clamps, custom fabricated clamps, and cast, forged, or welded enclosures (whether or not welded to process equipment). **NOTE**: Sealant injectors and specialized injection fittings are not considered appliances, as they do not reduce or remove stresses in the primary pressure containment hardware.

*2.4 High Temperature and High Pressure Definition for this Instruction: High pressure is defined by pipe class with a flange rating of 600# or greater and high temperature is defined as 500°F and greater.

2.5 Hazardous Materials for this Instruction: Hazardous materials follow OSHA 1910 which include NH_3, H_2S, chlorine, and LPG.

*2.6 Critical Service Leak Repairs Leak repairs on high temperature (500F° or greater), high pressure (600# flange rating or higher), hazardous process materials (acid, caustic, chlorine, H_2S, NH_3, LPG, etc.), and pressure seal valves.

*2.7 Low Hazard Utility System: Firewater, Drinking Water, Fresh Water, Reclaimed Water, DWOP Water, Effluent Water, Yard Air, and Instrument Air.

*2.8 "Reinjection of hardening sealants:" Reinjection which occurs after the initial injection sealant has cured completely. Curing will generally be complete after 72 hours. The engineering review for reinjection is triggered after the initial leak

seal work is completed, sealant has cured, leak still exists, and then another attempt/injection is made.

3.0 OTHER APPLICABLE STANDARDS

The following documents outline other relative Instructions and policies:

*Refinery Instructions	302	Color Identification/Labeling of Equipment and Pipelines
	321	Preventing Exposure to Corrosive Chemicals and Defining Yellow-Lined Areas
	368	Mechanical Integrity
	370	Management of Change
	601	H_2S Handling Equipment
	9900	Release of Equipment for Mechanical Work
Engineering Instruction	E-671	Hot Tapping Lines, Vessels, and Storage Tanks
American Petroleum Inst.	570	API Piping Inspection Code

4.0 GENERAL RULES

Permanent repairs are preferred to all types of temporary repairs. All on-line leak repairs shall be governed by the following general rules:

*4.1 Authorization to perform on-line leak seal job requires approval by a Refinery Business Manager at the initiation of any leak seal work. A designee may be assigned only for Type 1 repairs with low hazard utility service (*refer to 2.7 and Section 5*). *"Critical Service Leak Repairs," as defined in 2.6, must be approved by Plant Support Team Leader, Maintenance Manager, and the Operations Manager.*

On-line leak seal repairs are normally reserved only for situations where the leak cannot be isolated. If a leak is in a location where isolation is possible, an on-line leak seal repair should be considered only after isolation has been attempted and has proven unsuccessful. A successfully isolated leak using single block valves to make a permanent repair is preferred over a temporary on-line leak seal.

To avoid attempting a permanent repair on isolated equipment using single block valves, the argument is made that the state of isolation valves and hardware may change during the repair. Probability of this occurring is very low and is a

manageable risk. In contrast, experience has shown that the state of the pressure containment hardware—both permanent plant equipment and temporary leak seal appliances and leak seal hardware experience changes during on-line leak seal operation (drilling, pumping of sealants, venting, pressurization to sealant injection pressures, depressurization, curing, shrinkage, etc.) which may not be successfully managed and which cannot be known with certainty. In contrast, once single block valves have been closed, the system cooled and vented to ambient conditions there is minimal risk of change.

The leak seal checklist has a mandatory box "Leak cannot be isolated and depressured with plant in service" which must be answered True/False and signed by the Section 2 Reviewer for the leak seal to proceed.

*4.2 All temporary on-line leak repairs require the completion of a Leak Seal Review (LSR) form on the PSM/MOC database. Each temporary repair will be tracked through the LSR process. The expiration date on the LSR form will be based upon available maintenance opportunities and established criticality.

*4.3 Replacement of temporary repair arrangements with permanent repair materials and procedures shall be made at an appropriate maintenance opportunity based upon equipment criticality. Critical leak sealed equipment shall be replaced at the first available opportunity. Note that permanent repairs for Type III, having no pressure stressed appliances, can be deferred through the LSR process (Reference Section 5, Note 4). Examples of this are flat face ungasketed split casings of machinery, which have been leak sealed.

4.4 Permanent repairs shall include removal of all temporary clamps, appliances, or patches. Certain Type III injection fittings screwed directly to the process equipment (not employing appliances) may be made permanent. (See notes below and Section 5.3.) If the injection fitting screwed directly to the process equipment (not appliance) is removed, the threaded opening into which the injection fitting has been installed must be plugged with a solid threaded plug, with seal welding requirements dependent on application case-by-case.

4.5 The Contractor for leak seal work shall provide personnel who are thoroughly trained and qualified regarding the equipment, materials, and techniques commonly used for on-line leak repairs. Sealing compounds shall be resistant to the process fluid, suitable for the operating pressure and temperature, and shall maintain their minimum necessary physical and chemical characteristics for at least a four-year period. The Company is to use the LSR in Appendix 1 as the means of advising the Contractor of all operating conditions. The Contractor will select the appropriate sealant on this basis and maintain a written record of sealant used.

*4.6 In order to ensure the safety and integrity of the leak seal procedures, the responsible Maintenance supervisor or Contractor Representative must ensure that leak sealing personnel (Company or Contractor) completely understand the required leak seal procedures, the plant-specific hazards, and have drawings or a knowledge of the internal profile of the equipment to be sealed. This may include supplying detailed drawings, radiography, sample valves, components for disassembly, and/or ultrasonic thickness readings. Leak sealing work requests and work orders must use accurate operating pressure, temperature, and fluid characteristics.

4.7 Critical Service Leak Seal Repairs require special treatment. All Company and contractor personnel involved with leak seal activity must recognize such jobs require Chevron and leak seal contractor engineering review, including leak seal contractor's critical job procedures, special consideration requiring additional procedures such as leak seal contractor's critical job procedures, and standby Chevron safety operator, Pressure seal valves are a special case requiring engineering review and valve manufacturer drawings to determine the suitability of such valves for leak sealing. (Pressure seal valves generally occur in pipe classes having 600# flanges or greater.) Note that it is generally not recommended to attempt leak sealing any valve where more than one wall must be drilled through to gain access to the leak source.

*4.8 An Engineered Composite Line Wrap Repair shall be employed per this instruction to solely help mitigate a potential leak before it occurs. An active leak will require the component be taken out of service to repair using this method. Consult the Area Design Engineer and the Material's Engineer regarding this repair option. Engineering calculations will be required to help determine job scope and a temporary leak seal shall be created to track the wrap. The success of the repair is highly dependent upon several factors which include service temperature, cyclic stress, surface preparation, and size of the damaged area.

*4.9 Temporary Leak Seals (TLS) on ASME Section 1 & Section 8 equipment and B31.1 piping are non-discretionary work list items. State acceptance is required to deviate from performing permanent repairs at the next available opportunity.

*4.10 **Exceptions to API 570 Repair categories** (excluded piping systems)

a. Steam, condensate, water, air.

b. Category D fluid service (non toxic, non flammable, non harmful to human tissue, $\leq$ 150 psi design pressure and temperatures from -20F through 366F).

c. **Note:** The California State Safety Orders (CSSO) take specific exception to the exclusions above and direct us to create an inspection & testing program for these systems. TLS's installed on these systems will be evaluated for repair as discretionary items.

d. Although the CSSO's do not specify a repair strategy (there is no requirement to consider a repair during a specific TA or other repair opportunity) the State has given guidance that a repair strategy was intended under the orders. During the Sept 2006 Ca Petroleum Safety Order Training it was communicated that there needed to be an inspection & *maintenance* program for the API 570 excluded categories. Our recommendation after consultation with Safety is that these systems be considered as TA scope items, but managed as discretionary work.

5.0 TYPES OF REPAIRS AND REQUIRED APPROVAL LEVELS

There are four basic categories of repairs which will be considered by type in this Instruction. The required approval levels for the various categories of on-line repairs are summarized below. The leak seal review is part of the MOC process and access to the leak seal checklist is through the LSR Access database. Engineering and Inspection help should be solicited by Maintenance and Operations personnel if there are any unanswered questions or unusual conditions relating to the repair. Approval levels are designated below by repair type.

Special Note: Flange Leaks – Sealing Without Using Specialized Leak Seal Hardware – Spiral Wound Gaskets and Inner Rings

*This Refinery Instruction addresses the situation where specialized leak seal hardware and sealants are employed for on-line leak repair. However, many flange leak seal situations will not require specialized hardware. For gasketed closure leaks normally the first attempt at stopping the leak should be to retighten the bolts.

*Refer to GEN-5209 for Bolting and Sealing. A link to GEN-5209 is located in the Official Maintenance Instructions Table of Contents web page (scroll down).

http://www.ric841.chevron.net/REFERENC/MNT_INST/MI-toc.htm

NOTES:

(1) All on-line temporary leak repairs require a LSR and a Maximo WR/WO. An engineered work order is required for Type IV work and shall accompany the Maximo WR/WO and LSR. The Plant Support Engineer (PSE) should prepare this.

(2) All on-line leak repairs require an LSR. (Reinjections of hardening sealants in hydrocarbon and critical services do not require a new LSR but do require a new JJSV and engineering review be performed and documented with the original LSR.)

*(3) The California Code of Regulations Title 8 does not recognize "temporary repairs" on Pressure Vessels (ASME Section 8) or Boiler Code equipment (ASME Section 1 and ANSI B31.1). If it is necessary to encapsulate, apply a lap patch, or otherwise not bring the object back into original condition, California Department of Occupational Safety and Health (DOSH) acceptance of the leak repair plan is required. The repair shall be performed by Chevron or a National Board R certificate holder. If performed by an R Certificate holder, the contractor shall develop the repair plan which will be reviewed and accepted by PSE prior to submitting to DOSH for acceptance. If the repair will be performed by Chevron, the Plant Support Engineer (PSE) will develop the repair plan in the form of an Engineering Work Order (EWO). A Maximo WR/WO shall be developed to track work. DOSH acceptance of the leak repair plan is required. In some instances, a Fitness for Service Review must be initiated. All of these repairs shall be removed at the next turnaround. Exceptions shall be evaluated through the MOC process.

*(4) Temporary Repairs – The following are considered temporary repairs that must be addressed per the LSR Methodology: Type I, Type II, Type III having pressure-stressed appliances other than injection fittings, and Type IV. Note that Section 5.3 allows for an MOC to extend the expiration date of leak seals.

Type III (Section 5.3) Temporary Repairs that can be renewed or made into permanent repairs through the MOC process are:

*1. Type III Injection fittings installed on valve bonnet and valve packing boxes for stem sealing: An MOC can be created prior to injector installation in these locations to make the injectors fittings permanent (Reference RI-370). In addition, an LSR can be created, be kept open, and be repeatedly renewed for these fittings if desired. Note that thread engagement length equal to one diameter of the injector fitting is required. API 570 does not designate specialized leak seal injector fittings as temporary hardware as it does clamps and enclosures.

*2. Type III Injection fittings may be tapped directly into process equipment (at locations other than the valve bonnet/stem) without other appliance hardware: These injection fittings cannot be made permanent, but they can be indefinitely extended via the MOC process on a case-by-case basis. These repairs will generally not be applied to Boiler Code (ASME Section

I and ANSI B31.1) vessels and piping, but if they are, 5.0 Note (3) above applies. It is possible to complete/close LSRs for these repairs if an MOC is created and the design conditions are evaluated to allow for an extended run interval. Expiration calendar dates for extensions shall correspond to five years from installation/renewal or the next major plant turnaround, whichever is sooner.

(5) Reinjections of Existing Temporary On-line Leak Seals

1. Reinjections for non-hardening sealants (also called "pumpable packing" or equivalent) such as valve stem seal packing, there is a 3 reinjection limit without requiring an engineering review and a new LSR is required after the 3 reinjections. (Stem packing is a sealant lubricant and is generally considered a normal maintenance activity for the dynamic stem to bonnet seal. However, valves requiring frequent reinjection should trigger valve stem maintenance and/or repacking during the next planned maintenance window.)

2. For Sealants Which Harden

   a. An engineering review and new Health & Safety Evaluation are required before every reinjection in hydrocarbon and/or Critical Service. The HSE review documentation shall be added to the original LSR. The intent of the review is to verify the suitability for more injections and to check the leak and failure mechanisms such as corrosion and pipe stress have not changed, and to validate the acceptability of additional injections. Review documentation should be added to the original LSR and engineering files. A new LSR is not generated for these reinjections. This paragraph applies to Types II and III.

   b. Reinjections of clamps in noncritical service (i.e., water, low pressure steam, condensate, etc.) may not require engineering review. However, engineering review is recommended after the 4th reinjection for the same reasons as cited in (6) (2) (a) above. This paragraph applies to Types II and III.

      NOTE: Initial installation of clamp will require "reinjection" due to shrinkage and other factors. These will not count towards the reinjection definition noted above (within 72 hours of clamp installation).

(6) Use of High Pressure Packing Glands and Drill Stops – The use of high-pressure packing glands (HPPGs) and mechanical drill stops is required for Type III leak repairs in Critical Services (See Section 4.8). HPPGs and drill stops are also required for reinjections of Type II clamps and enclosures in Critical Services.

The four types of repairs are listed below:

5.1 Type I repairs are standard pipe clamps with no injections (such as a skinner clamp):

1. Type I repairs require the following:

   a. Leak Seal Review

   b. Maximo WR/WO

2. Type I repairs require approval by:

   a. The Section 2 Reviewer

   *b. The Refinery Business Manager or designee (*Type 1 and Low Risk Utility Service)*

   *c. The Owner User Inspector (OUI=Fixed Equipment Inspector)

   *d. Plant Support

*3. API 570 repair category and mitigation requirement:

Non-welded repairs (e.g., properly designed bolted leak clamps):

   a. Shall be removed and restored to original integrity during turnarounds or other appropriate opportunities. Priority of the repair shall be established based upon risk review. Other appropriate opportunities are interpreted to mean when the system is cleaned for work other than the removal of the non welded repair. The term "shall" makes non-welded repairs nondiscretionary under the code, and a repair plan must be developed.

4. **CAUTION**: Pipe clamps and pipe longitudinal separation risk for Type I Repairs: Circumferential UT wall thickness measurements are required to verify metal thickness is adequate to prevent pipe separation under the clamp in the corroded area during the estimated time the clamp will be

installed. This is necessary to ensure that sufficient wall thickness exists to prevent line separation failure if corrosion (internal and external under appliance) is general around the entire circumference of pipe. Pipe clamps generally afford hoop (circumferential) stress reinforcement but not longitudinal separation restraint. Reference API 570 Section 6.1.4 which uses the terms "axial thrust load" and "pressure thrust" in discussing longitudinal separation. If separation is a concern, special pipe clamps with crunch teeth to engage pipe or other designs are employed by leak seal contractors. See Appendix VI "Design for Axial Loading."

*5.2 Type II repairs include the following: Enclosures such as wire wrap/injections, hot bolted/injections, peening methods, engineered composite wraps, and fabricated clamps/injection with no drilling in equipment.

*Reference RI-9900, Appendix C, Section 1.5 for Single Stud Replacement.

1. Type II repairs require the following:

   a. Leak Seal Review

   b. Maximo WR/WO

2. Type II repairs require approval by:

   a. The Section 2 Reviewer

   b. The Area Business Unit Manager

   *c. The Owner User Inspector (OUI=Fixed Equipment Inspector)

   *d. Plant Support Engineer

*3. API 570 repair category and mitigation requirement:

   Non welded repairs (e.g., properly designed bolted leak clamps):

   Shall be removed and restored to original integrity during turnarounds or other appropriate opportunities. Priority of the repair shall be established based upon risk review. Other appropriate opportunities are interpreted to mean when the system is cleaned for work other than the removal of the non-welded repair. The term "shall" makes non welded repairs non discretionary under the code and a repair plan must be developed.

4. **CAUTION**: Type II clamps do not normally provide axial restraint to prevent pipe separation. Circumferential UT wall thickness measurements are required to verify metal thickness is adequate to prevent pipe separation under the clamp in the corroded area during the estimated time the clamp will be installed. This is necessary to ensure that sufficient wall thickness exists to prevent line separation failure if corrosion is general around the entire circumference of pipe. Pipe clamps generally afford hoop (circumferential) stress reinforcement but not longitudinal separation restraint. Reference API 570 Section 6.1.4 which uses the terms "axial thrust load" and "pressure thrust" in discussing longitudinal separation. If separation is a concern, special pipe clamps with crunch teeth to engage pipe or other designs are employed by leak seal contractors. Such designs require engineering review. See Appendix VI "Design for Axial Loading." Larger diameter lines can be eccentric (>6"), they should be checked for roundness prior to installing a clamp. Refer to Section 6.5.2.c.

5.3 Type III repairs include the following: Drill and tap/injections into the process equipment.

1. Type III repairs require the following:

   a. Leak Seal Review

   b. Maximo WR/WO

2. Type III repairs require approval by:

   a. The Section 2 Reviewer

   b. The Refinery Business Manager

   *c. The Owner User

   d. The Lead Plant Support Engineer. An engineered work order may be required.

3. Type III drill and tap repairs fall into three types:

   IIIA Valve Stem Packing Injection Fittings – Stem sealant injection fittings which essentially duplicate commercial design meeting ANSI piping code, and piping classification materials class may be made permanent, refer to RI-370. (Check thread engagement length equal to

injector thread diameter, location of injection relative to packing rings, lantern rings, packing box neck ring location, etc.) It is not the intent of this Instruction to make retrofitted valve stem sealant injectors become the norm. Example: A valve stem packing leaks on a plant valve. This valve had been purchased without a stem sealant injector fitting. The same or similar valve for the pipe class can be supplied with a non-seal-welded stem sealant injector fitting. Retrofitting an injector fitting to the plant valve or replacing the plant valve bonnet packing box with the box having the injector fitting are both changes which can be made permanent under this standard. Injector fittings are typically small, 1/8-1/4" stainless steel, short and have small cantilevered mass. Specialized leak seal injector fittings are not specifically designated as temporary hardware which must be removed by API 570. These specialized low mass injector fittings are considered the same as process instrument tubing for the purposes of seal welding. Seal welding could damage these small injector fittings and is not required. When standard piping class valves and pipe are used in the stem leak seal hardware, these are considered temporary by API 570 Section 6.1.4 and must be removed at turnaround or other appropriate opportunity. This means that if pipe nipples and couplings are used to extend the connection of the leak seal fitting, these components cannot be made permanent.

NOTE 1: Because sealant generally does not provide the structural support of packing, there will continue to be the need for valve stem packing replacement during maintenance outages.

NOTE 2: Close coordination between Leak Seal Contractor, valve manufacturer and Chevron representative is essential to determine whether a valve is a viable candidate for stem sealant injection and then to assure valve dimensional data is correct. The valve manufacturer is often needed for dimensional information.

IIIB Other Sealant Injection Fittings screwed to process equipment not employing pressure containing appliances (clamps, enclosures, wire wrap) – these fittings cannot be made permanent, but they can be renewed (postponing permanent repairs) via LSR ~~(see LSR Methodology).~~ Permanent repairs are not required as long as the initial change (installation of sealant injectors) continues to be tracked and periodically renewed in the LSR database. Removal of sealant fitting and replacement with screwed plug will constitute permanent repairs. Seal welding requirements for screwed plugs are to be determined on a case-by-case basis. (Reference API 510 & API 570 for definitions of "temporary

repairs." The intent of RI-621 is to comply with these guidelines.) Examples of this type of repair are machinery cases with flat face metal-to-metal sealing surfaces. Injector fittings which have been installed to inject sealant between faces may be renewed.

IIIC Appliances Incorporating Injector Fittings – Type IIIC Appliances (pressure-containing clamps and enclosures) are always considered temporary. Permanent repairs require removal of appliance. Appliances cannot be left indefinitely. They are to be removed at the next plant maintenance shutdown opportunity.

5.4 Type IV repairs include the following: All services in which a leak sealing enclosure is welded to equipment.

1. Type IV repairs require the following:

   a. Leak Seal Review

   b. Maximo WR/WO

   c. Engineered Work Order

2. Type IV repairs require approval by:

   a. The Section 2 Reviewer

   b. The Refinery Business Manager

   c. The Owner User Inspector

   d. The Lead Plant Support Engineer

*3. API 570 repair categories and mitigation requirements:

   a. **Welded permanent repairs**:

      No mitigation required.

   b. **Welded temporary repairs** (e.g., full encirclement welded split sleeves or box-type enclosures designed by a piping engineer):

      Should be removed at the next available maintenance opportunity. Priority of the repair shall be established based upon risk review. The term "*should*" makes welded repairs discretionary under the

code. If a decision is made not to remove and perform a permanent repair the TLS shall be evaluated by a piping engineer with the assistance of the API 570 piping inspector to determine if the temporary repair is adequate. The new repair date shall be documented in the TLS database, and the associated risks and mitigations associated with the extension shall be documented in the HSE.

6.0 RESPONSIBILITIES

On-line repair work shall be initiated and executed as follows:

6.1 The Head Operator/Operations Maintenance Coordinator (OMC) shall originate a Maximo Work Request (coding the WR as a leak seal job), a Leak Seal Review describing in detail the location, type of leak, and material leaking AFTER the Head Operator has confirmed that the piece of equipment to be repaired cannot be taken out of service.

Determine the type of leak repair required as defined in Section 5.0. That determination may be made in consultation with other personnel such as Engineering, Inspection, and/or a leak seal Contractor.

The Head Operator/OMC is to enter the line identification number in the Maximo Work Request as the equipment ID. The line identification number is the Inspection Isometric Drawing for the piping on which the temporary leak repair is to be installed. The Isometric Drawings can be found on the Richmond Web Page under reference:

http://www.ric841.chevron.net/Inspdwgs/Insp-Pipe.htm

*6.2 The Area Business Unit shall review and approve the Maximo Work Request. The STL, OMC (SME), or OA shall verify whether or not the leak can be isolated. If not, The STL, OMC (SME), or OA shall create an LSR/MOC and notify the RBM or designee (*for Type 1, Low Hazard Utility Service only*) that the Leak Seal Review Checklist requires their approval. The work request can be created, but will not be approved into a work order until Stage 1 of the LSR/MOC is completed. Afterwards, the Planning and Scheduling group can plan and schedule the work. The approved Maximo WO will be released to the responsible Maintenance Supervisor or Contractor representative.

The need for a temporary leak repair indicates that there is a system failure. The Shift Team Leader must initiate a failure analysis per the Failure Analysis Process. Refer to this process located on the Richmond Web Site under references:

http://www.ric841.chevron.net/failureanalysis/failureanalysis.asp

6.3 The Refinery Business Manager shall review and approve or disapprove the proposed work based on all relevant operating and safety issues.

6.4 A Safety Operator shall stand by during the execution of leak sealing work on plant equipment if the work involved meets any one of the safety criteria in safety considerations box on the leak seal checklist: >500F, >/= 600# flanges, hydrocarbon, hazardous chemical, above auto-ignition temp, corrosive, breathing air, acid suit, critical. If the work does not have any of the above safety criteria the standby operator can be waived with the documented approval on the HSE of the LSR of the Operations Assistant or Shift Team Leader. Special consideration is necessary for acid, caustic, LPG, NH_3, high pressure (flange rating 600# or greater), high temperature, flammable and auto ignition services. The Safety Operator shall be advised by the Plant Support Engineer or Maintenance Supervisor and leak seal contractor personnel of key leak seal procedure issues, hold points, etc. so he can more closely follow the work and recognize problems and issues and call in assistance as needed during work execution. (Example. The PSE may wish to be notified by Safety Operator if injector valves are unavailable or cannot be used on all injection points on a flange clamping ring as was planned.)

6.5 The responsible Maintenance Supervisor shall:

1. Inspect the component/assembly to be repaired to confirm that it cannot be sealed without leak sealing materials and procedures.

*2. If an engineered work order is not required, the responsible Maintenance Supervisor or Planner shall attach to the Maximo WO the Leak Seal Review number and the appropriate Equipment-Specific Work Procedure(s) from Appendix II, then obtain the required approvals and perform the repair or have it done by a leak seal Contractor. A Contractor representative shall be held responsible to communicate hold points and other safety issues with the safety operator if work is to be performed with a leak seal Contractor.

*3. If an engineered work order or LSR design review is required per Section 5.0, the responsible Operating Assistant shall notify the Daily PSE

who will then be responsible for the engineered work order or design review preparation and for obtaining the approvals required by Section 5.0. The Maintenance Supervisor shall then route forms (Maximo WR/WO, Leak Seal Review, and engineered work order, design review) for performance of repairs.

*4. The responsible Maintenance Supervisor and Engineer will confirm ~~that~~ the leak sealing technique performed by the Contractor conforms with the Equipment-Specific Work Procedure from Appendix II, and/or with the engineered work order attached to the Maximo WR/WO, Leak Seal Review and will comply with the leak seal contractor's written leak seal procedure specific to the job. It is the responsibility of the Maintenance Supervisor or Contractor representative to review the job and advise engineering personnel of planned deviations from written procedures (example: geometry does not allow use of all injection ports on a standard ring type clamp, etc.).

5. The Maintenance Supervisor is responsible to verify clamp fit-up per contractor's specification on all non- "critical" leak repairs.

*6.6 Responsibilities of Owner User Inspectors (OUI) (=Fixed Equipment Inspectors)

1. Fixed Equipment Inspector shall provide review of leak seal jobs originating during plant operation. The Fixed Equipment Inspector's review and approval of Leak Seal Review Checklist is required for on and off-plot equipment and piping operating in services as defined by API 570 Classes 1, 2 and 3 (flammable hydrocarbons and hazardous chemicals) and ASME Section 1, Section 8 and ANSI B31.1 "code" equipment, including especially type III and IV repairs. On other non-API 570 and non-code equipment, when requested, Inspector shall verify circumferential wall thicknesses for Type I and II clamps and work with Daily PSE to determine whether thickness is adequate to prevent pipe separation during the lifetime of clamp at expected corrosion rate (internal and external under appliance). Wall thickness and other NDE work requested for non-API, non-code equipment will normally be done on routine day shift priority. Inspector shall verify leak seal jobs have been entered into RFMS database(s) and supply additional nondestructive examinations as requested, such as radiography.

2. Turnaround Area Inspector shall provide review of leak seal jobs which will not be permanently repaired during the shutdown, per the LSR Methodology, and participate in the LSR renewal process/MOC process. Update fitness for service database.

*6.7 Responsibilities of the Plant Support Engineers. Upon notification by the responsible Operating Assistant, the daily PSE shall perform an LSR design review and complete remaining sections of the Leak Seal Review Checklist. The engineer shall work with operations, maintenance, and inspections to develop a thorough work plan with consideration of all possible hazards. The following items should be included in any considerations made by the engineer:

1. Metallurgy: All stud bolts, packing gland studs, valve stems, etc., which have been exposed to leaking steam or boiler feedwater above 110°F for several days are subject to caustic cracking. The listed hardware is subject to chloride stress corrosion cracking if chlorides are present with metal temperatures above 140°F. Special consideration should be given to the need for inspection by UT testing, or replacement of all bolts or studs prior to a temporary leak repair using high pressure sealant injection. It is often recommended to replace studs with Teflon-coated "blue bolts" to resist caustic cracking, temperature permitting.

    a. B-7 Stud bolts are also subject to sulfide stress cracking (H_2S, sour water) at temperatures below 200°F.

    b. Stainless steel bolts are subject to chloride cracking at temperatures above 140°F. Consult the Materials Engineer as necessary.

2. Safety aspects and mechanical integrity must be reviewed and considered with regard to the proposed repair to include:

    a. Safety Relief Valves: Sealant injections shall not be made into any relief valve, pressure relief valve, or bursting disc if the sealant could obstruct their free and full discharge requirements.

    b. Calculate Overstress: Leaks at flange/flange joints are often repaired by installing a clamp around the circumference of the joint, or by lacing barrier wire between flange faces but outside the bolt circle, or by peening the edges of the two flanges together. Then sealant is pumped into the area between the flange gasket and the sealing mechanism. Prior to or during injection of the sealant, a larger surface area of the flange face may be subjected to full line pressure. On Class 600 and higher rated flanges, the added bolt stresses resulting from containment will usually exceed the maximum allowable tensile load of the bolt material (engineering review required for these). This applies not only to narrow gasket

width flanges like tongue and groove, male and female, ring joints, "O" rings, or special wedging-type seal rings, but also to wider gasketed flanges like raised-face. Special clamping devices will often be necessary to keep the bolt stresses within allowable limits. After the injected sealant has "cured," the bolt loads will often be less than normal due to the reduced gasket factor "m," and design seating stress "y" of the rubber-like sealing compound. Refer to ASME Boiler & Pressure Vessel (B&PV) Code, Section VIII, Appendix II for gasket seating requirements. (Cold/Hot Bolt stress calculations are provided for 900# – 2500# flanges: O:/erg/public/fer/RI621/isherwood flangecalc.xls.)

c. Collapse Pressure: Extra caution must be exercised in applications whereby excessive external pressure can be applied by sealant injection on cylindrical or spherical shapes. Normally, leak seal jobs require sealant be injected with process equipment pressured to service pressure. When this is the case, this internal service pressure will help to resist the external pressure from sealant injections. In calculating allowable sealant injection pressure, the actual service pressure of the equipment shall be used. Alternately, if the equipment is not pressured during sealant injection, the collapse pressure of thin-walled cylindrical members can be calculated by formulas in the Standard Handbook for Mechanical Engineer, 8th Edition, pages 5-49 and 5-50. Also, wall thickness and stiffening requirement procedures for external pressure shall be followed as outlined in Paragraphs UG-28, UG-29, and UG-30 of Section VIII, Division 1 of the ASME B&PV Code.

d. Longitudinal Stress: In piping, pipe clamps provide circumferential (hoop stress) restraint but not longitudinal restraint. A clamped pipe may separate and pull out of the clamp due to longitudinal stress caused by internal pressure and or other stresses such as bending, weight, thermal growth/contraction, reaction forces caused by fluid change of momentum at elbows, etc. Pipe longitudinal separation is a risk for Type I and II Repairs: Circumferential UT wall thickness measurements are required to verify metal thickness is adequate to prevent pipe separation under the clamp in the corroded area during the estimated time the clamp will be installed. This is necessary to ensure that sufficient wall thickness exists to prevent line separation failure if corrosion is

general around the entire circumference of pipe. Additional engineering design considerations are contained in Appendix VI.

e. Pressure seal valves are a special case requiring engineering review to determine the suitability of such valves for leak sealing. Locations of pressure seal rings, segment rings, retaining rings, and stuffing box are some of the factors which determine whether on-line leak seal procedures should be applied to pressure seal valves.

f. Verify the requirement to use high-pressure injector packing glands by leak seal contractors on all services except steam, water, and air. Communicate this requirement to the Safety Operator so Safety Operator can audit job for compliance. (**NOTE**: Leak seal contractor procedures may not have this requirement so Company employees involved in leak seal jobs are responsible to check that this requirement is met. If the job does not allow for the use of HP injector glands at all injection points, this is a Hold point for further review and determination of how or whether to proceed with the work.)

g. Vibration: Determine whether vibration is a consideration for design in leak seal hardware and remaining life of equipment being sealed.

h. Corrosion Rate: When leakage is due to metal loss, the future corrosion rates (internal and external under appliance) should be considered. Consider whether thinning will extend beyond the leak seal appliance.

i. Service Life: The rate of corrosion or degradation from all sources should be considered in establishing permanent repair date.

j. Welding: Review and or select welding procedure(s).

k. Engineer to confirm and field verify with contractor field fit up of appliance to meet engineering tolerances for all "critical" type leak seals.

l. Engineer to review appliance support details and determine if additional support is needed. Temporary support is not recommended. Line vibration must be considered when reviewing support details.

3. The engineer shall indicate in the LSR if the Equipment-Specific Work Procedure(s) from Appendix II are adequate to complete the job. If the Equipment-Specific Work Procedure(s) from Appendix II are not adequate, an engineered work order shall be completed. If the work is to be done by a leak seal contractor, the Engineer shall review and approve the specific leak seal procedure and engineered appliances to be employed in consultation with the leak seal contractor. The completed engineered work order should be routed to the responsible Maintenance Supervisor for execution. The PSE shall discuss key procedure issues, hold points, etc., with the Safety Operator to audit work progress and compliance to the procedure as work is performed.

6.8 The Lead Plant Support Engineer shall review/approve all engineering work performed by the Plant Support Engineer.

6.9 Final approval level for all emergency, weekend, or evening on-line repair work shall be the Shift Team Leader in consultation with the Refinery Shift Leader, Refinery Maintenance Coordinator, and leak seal contractor, if used.

6.10 Tracking & LSR Closure: On-line leak repair is a change and as such, will be tracked through the LSR process and uniquely-coded attribute in Maximo. Engineered leak seal work orders will use the same code unique to all leak seal repairs. The expiration date on the LSR form should correspond to the next planned plant shutdown. At the expiration date of the temporary change, the Section 2 approver will review the change to determine whether to extend or remove the change. The Refinery Business Manager or Shift Team Leader must approve any extensions of temporary changes per RI-370 (Management of Change). The LSR is not to be considered complete until the temporary change has been made permanent.

*7.0 MATERIALS

All materials, design calculations, clamps, boxes, and any other enclosures used for leak sealing will normally be supplied and installed by the Contractor. All materials shall be compliant with the applicable Code. These devices then become the property of Chevron.

8.0 PROCEDURAL DOCUMENTS

The following Appendices contain examples of procedural documents:

*8.1 Appendix I – Example of a Leak Seal Review Checklist. An electronic form is currently filled out on the PSM/MOC database.

8.2 Appendix II – Equipment-Specific Work Procedures for routine-type repairs usually qualifying as Type I or Type II repairs.

8.3 Appendix III – Equipment-Specific Drawings detailing typical Types I, II, and III repair methods as defined in Section 5.0. These drawings depict the placement of barrier wire, ring adapters, clamps, and other enclosing devices as well as sealant injectors.

8.4 Appendix IV – Leak Seal Contractor Work Procedures by contractor.

8.5 Appendix V – Work Flow Diagram for Leak Sealing Procedures.

Contractor leak seal procedures are confidential and proprietary and are not to be divulged to their competitors. Access to leak seal contractor procedures is restricted to preauthorized Company personnel.

a. TEAM procedures

b. Koppl/Flowserve procedures

c. Furmanite procedures

8.6 Appendix VI – Engineering of Temporary Leak Repair Devices to Withstand Axial Loads.

EXAMPLE - LEAK SEAL REVIEW CHECKLIST

LEAK SEAL REVIEW CHECKLIST

You have been assigned a Leak Seal Review. This checklist is a guide to help ensure that all information necessary to evaluate the change is considered.

Leak Seal Number: _____
Date of Review: _____
Completed By: _____
Person Responsible: _____

OPERATIONS SECTION: *The Head Operator shall originate a Maximo Work Request (coding the WR as a leak seal job), an RI-621-I, Leak Seal Review describing in detail the location, type of leak, and material leaking AFTER the Head Operator has confirmed that the piece of equipment to be repaired cannot be taken out of service.*

Equipment/Location Description:

HO: _____ HO Phone: _____ Cannot Be Isolated: Yes Priority: _____
Line No./Equip. No.: _____ Location: _____ Line Size: _____
Process Temp.: _____ Process Pressure: _____ Process Description: _____

Safety Precautions: ☐ **Safety Operator Required**

☐ Hazardous ☐ Corrosive ☐ Flammable ☐ Critical Job ☐ Above Auto Ignition
☐ Acid Suit ☐ Breathing Air ☐ Above 500F ☐ 600# or above Flange
☐ Other Hazards/Safety Precautions:

☐ Valve Packing ☐ Valve Bonnet ☐ Valve Flange ☐ Pipe Flange ☐ Pipe Fitting
☐ Pipe (hole) ☐ HEX Tube Sheet ☐ HEX Channel ☐ HEX Cover ☐ Pressure Seal Valve
☐ Other _____ ☐ Staging Required? ☐ Reinjection? ☐ Repair Type

Maximo Work Request No.: _____ P&ID No.: _____
Operations Review/Comments:

MAINTENANCE SECTION: *Maintenance Supervisor shall inspect the component/assembly to be repaired to confirm that it cannot be sealed without leak sealing materials and procedures.*

Maintenance Supervisor: _____ Maintenance Supervisor's Phone No.: _____
Leak Seal Contractor Contacted: Yes Contractor Proposal Received: Yes Maximo W/O No: _____
Maintenance Review/Comments:

INSPECTION SECTION: *Fixed Equipment Inspector shall provide review of leak seal jobs originating during plant operation.*

Inspector: _____ Inspector's Phone No.: _____
Additional Staging Required: Yes UT Required: No X-Ray Required: No Code Repair: No
Inspection Review/Comments:

ENGINEERING SECTION:

DPSE: _____ DPSE Phone: _____ Critical Leak Seal: Yes EWO No.: _____
Pipe Class: _____ Design Pressure: _____ Design Temp.: _____ Metallurgy: _____
Equipment-Specific Work Procedure(s) from RI-621, App. II are adequate to complete the job? Yes
Design Review/Comments:

APPROVALS SECTION:

Fixed Equip. Inspector: _____ Date: _____
Lead Engineer: _____ Date: _____
RBM: _____ Date: _____
Operations Manager: _____ Date: _____
Maintenance Manager: _____ Date: _____
Design Manager: _____ Date: _____

RICHMOND REFINERY INSTRUCTIONS

FLANGE CLAMP, LINE, OR FITTING ENCLOSURE SEAL (TYPE II)

COMPONENTS TO BE REPAIRED – **FLANGE JOINTS** with gap width greater than 3/8". **PIPE OR PIPE FITTINGS** where thinning or weld failure has occurred.

Use this technique for safely repairing a leak on a set of flanges where a gasket failure has occurred and the width **exceeds** 3/8" gap or at a pipe, elbow, tee, etc., where thinning or a weld failure has occurred.

A. GENERAL INFORMATION

1. Determine the operating pressure, temperature, and service.

2. Take the component measurements.

   - The flange measurements will determine the style of clamp or box that will be designed (tongue type, packing type, "crunch groove" type).

   - The pipe component (elbow, straight line, etc.,) will dictate the design of the enclosure to be fabricated and installed over the leak.

3. Fabricate the clamp to an applicable design standard (ASME Boiler & Pressure Vessel Code, Section VIII, Div. I).

4. Obtain the proper Hot Work/Safety Permits.

B. REPAIR PROCEDURE

1. When possible, replace the flange studs one stud at a time.

2. Install the clamp or enclosure around the leaking flange or fitting.

3. At the point furthermost from the leak, attach the injection/pump gun to the leak sealant injector valve and begin pumping sealant.

*4. Pump sealant until resistance is met or sealant flow is obstructed. Do not exceed Maximum Allowable Working Pressure (MAWP) of clamp or maximum external line pressure allowed. The MAWP for the clamp will be determined by the clamp fabricator. The max external line pressure shall be established by the Plant Support Engineer (PSE). At this time, move to an injector valve on either side of the one just pumped through.

5. Continue pumping and alternating injection ports until all ports have been pumped and the leak has been sealed 100 percent.

6. Tag one of the injector valves with a job completion listing the compound used and the date of the repair.

FLANGE GASKET REPAIRS—WIRE WRAP/HOT BOLT (TYPE II)

COMPONENTS TO BE REPAIRED - **FLANGE JOINTS** with gap width less than 3/8".

Use this technique for safely repairing a leak on a set of pipe flanges or valve bonnet flanges where a gasket failure has occurred and there is a gap, but the width of the gap **is less than** 3/8".

A. GENERAL INFORMATION

1. Determine the operating pressure, temperature, and service.
2. Obtain the proper Hot Work/Safety Permits.
3. Job limitations - 3/8" gap and 850 psig steam or condensate.

B. REPAIR PROCEDURE

1. Tighten all flange studs.
2. One at a time, change out every other stud with a ring adapter (injector stud and nut), then replace the remaining studs also.
3. Install injector valves on the injector nuts.
4. Tie the proper wrapping wire to one of the studs and begin lacing the wire around the studs between the flange faces, keeping the wire as evenly layered as possible.
5. Keep tension in the wire wrap during the entire wrapping process and make periodic tie-offs during the wrap.
6. Wrap the wire until it is approximately even with the flange edge and make a final tie-off. Peening the flange over the wire is sometimes used in addition to seal severe and/or high pressure leaks.
7. At the point furthermost from the leak, connect the injection pump gun to the injector valve and begin pumping sealant.

*8. Pump sealant until resistance is met or sealant flow is obstructed. Do not exceed MAWP of clamp or maximum external line pressure allowed. The MAWP for the clamp will be determined by the clamp fabricator. The max external line pressure shall be established by the Plant Support Engineer (PSE). At this time, change to an injector valve on either side of the one just pumped.

9. Continue pumping and alternating injection ports until all ports have been pumped and the leak has been 100 percent sealed.
10. Close off the final injector valve just pumped through and remove the injection pump gun and allow the sealant to cure completely.
11. After the sealant cures, forming an exterior gasket, remove each injector valve and install a pipe plug in the injector nuts.
12. Tag one of the injector valves with a job completion listing the compound used and the date of the repair.

TYPE II

FLANGE GASKET REPAIRS—DRILL AND TAP INJECTION (TYPE III)

COMPONENTS TO BE REPAIRED - **FLANGE JOINTS** with minimal gap.

Use this technique for safely repairing a leak on a set of pipe flanges or valve bonnet flanges where a gasket failure has occurred and there is very little gap (often occurring on bonnet flanges of 2" or smaller valves).

A. GENERAL INFORMATION

1. Determine the operating pressure, temperature, and service.
2. Obtain the proper Hot Work/Safety Permits.

B. REPAIR PROCEDURE

1. When possible, replace the flange studs one stud at a time using boiler clamps.
2. Drill holes for 1/8" NPT threads between studs approximately 4" apart from outer circumferential flange surface at an angle to break through into gap area at bolt circle (outside stress area of flange). On full surface gaskets and metal-to-metal joints, drilling is done into stud clearance areas.
3. Tap holes for 1/8" NPT threads and install injector valves.
4. Insert tight fitting wire into gap around flange to form a dam.
5. Lightly peen lock edge of flanges over wire with bullnose peening chisel approximately 1/8" over gap size.
6. At the point furthermost from the leak, connect the injection pump gun to the injector valve and begin pumping sealant.
7. Pump sealant until resistance is met or sealant flow is obstructed. Do not exceed MAWP of clamp or maximum external line pressure allowed. The MAWP for the clamp will be determined by the clamp fabricator. The max external line pressure shall be established by the Plant Support Engineer (PSE). At this time, change to an injector valve on either side of the one just pumped.
8. Continue pumping and alternating injection ports until all ports have been pumped and the leak has been 100 percent sealed.
9. Close off the final injector valve just pumped through and remove the injection pump gun and allow the sealant to cure completely.
10. Tag one of the injector valves with a job completion listing the compound used and the date of the repair.

TYPE III

FLANGE GASKET REPAIRS—DRILL AND TAP REINJECTION (TYPE III)

COMPONENTS TO BE REPAIRED - **FLANGE JOINTS** with minimal gap.

Use this technique for safely reinjecting a leak on a set of pipe flanges or valve bonnet flanges where a gasket failure has occurred and there is very little gap (often occurring on bonnet flanges of 2" or smaller valves).

A. GENERAL INFORMATION

1. Determine the operating pressure, temperature, and service.
2. Obtain the proper Hot Work/Safety Permits.

B. REPAIR PROCEDURE

1. Be certain the 1/8" NPT injector valve is tightened securely into the neck of the valve.
2. With the injector valve in an open position, complete the drill-through into the stuffing box using a 3/16" drill bit.

   A drill-through chamber **must** be used when drilling a valve containing material other than steam, BFW, and condensate in order to contain the hazardous material, or on a pressure of 650# or more.
3. Once a blow is received, retract the drill bit and close the injector valve.
4. At the point furthermost from the leak, connect the injection pump gun to the injector valve and begin pumping sealant.
*5. Pump sealant until resistance is met or sealant flow is obstructed. Do not exceed MAWP of clamp or maximum external line pressure allowed. The MAWP for the clamp will be determined by the clamp fabricator. The max external line pressure shall be established by the Plant Support Engineer (PSE). At this time, change to an injector valve on either side of the one just pumped.
6. Continue pumping and alternating injection ports until all ports have been pumped and the leak has been 100 percent sealed.
7. Close off the final injector valve just pumped through and remove the injection pump gun and allow the sealant to cure completely.
8. Tag one of the injector valves with a job completion listing the compound used and the date of the repair.

TYPE III

LEAKING GATE REPAIRS—DRILL AND TAP INJECTION (TYPE III)

COMPONENTS TO BE REPAIRED - **GATE VALVE** with gate that won't seat.

Use this technique for safely repairing a leak-by condition on a small 2—6" gate valve.

A. GENERAL INFORMATION

1. Determine the operating pressure, temperature, and service.
2. Obtain the proper Hot Work/Safety Permits.
3. Valve should be in the fully closed position.

B. REPAIR PROCEDURE

1. Drill three to four holes (approximately 1 1/2-2" apart) for 1/8" NPT threads in the bottom gate seating area of the valve body. Do not break through into the body area.
2. Tap holes for 1/8" NPT threads and install injector valves.
3. Carefully drill through into the seat area just enough to get a "blow."
4. Connect the injection pump gun to the center injector valve and begin pumping sealant.
5. Pump sealant until resistance is met or flow is obstructed (working from the center injector outward the radius of the valve) and the leak has been 100 percent sealed.
6. Be certain each injector valve is closed off. Remove the injection pump gun and allow the sealant to cure completely.
7. Tag one of the injector valves with a job completion listing the compound used and the date of the repair.

TYPE III

VALVE PACKING—DRILL AND TAP INJECTION (TYPE III)

COMPONENTS TO BE REPAIRED - **VALVE STEM PACKING**

Use this technique for safely repairing a packing leak packing failure that has occurred and the packing gland has been adjusted to the fullest extent.

A. GENERAL INFORMATION

1. Determine the operating pressure, temperature, and service.
2. Determine the type of valve to be repacked (gate, globe, etc.).
3. Obtain the proper Hot Work/Safety Permits.

B. REPAIR PROCEDURE

1. Back seat the valve if possible.
2. Lubricate the eye bolts and nuts for adjustment.
3. Determine stuffing wall box thickness by measuring from outside of stuffing box to gland. Wall thickness must be equal to or greater than diameter of injector for sufficient thread engagement. **(On valves containing hydrocarbon, H_2S, caustics, or acids, the wall thickness should be UT'd or X-rayed.)**
4. Locate the proper place on the "neck yoke" and begin drilling (DO NOT PENETRATE THE INSIDE WALL OF THE STUFFING BOX).

   A drill-through chamber **must** be used when drilling a valve containing material other than steam, BFW, and condensate in order to contain the hazardous material, or on 650# or greater.
5. Tap the hole for 1/8" NPT threads.
6. Thread a 1/8" NPT injector valve into the tapped hole and tighten it securely.
7. With the injector valve in an open position, complete the drill-through into the stuffing box using a 3/16" drill bit.
8. Once a blow is received, retract the drill bit and close the injector valve.
9. At this time, begin the injection of the repack compound into the stuffing box.
10. Loosen the eye bolt nuts to retract the packing gland and resume pumping repack to completely fill the stuffing box.
11. Adjust the eye bolt nuts downward to compress the repack in the stuffing box.
12. Retract the packing gland again and resume pumping repack compound until the stuffing box is full and the packing gland is fully extended. (It may take more than two cycles to complete the repack properly.)
13. Close the injector valve and disconnect the injection/pump gun.
14. Tag the injector valve with a job completion listing the compound used and the date of the repair.

TYPE III

VALVE PACKING—DRILL AND TAP REINJECTION (TYPE III)

COMPONENTS TO BE REPAIRED - **VALVE STEM PACKING**

Use this technique for safely reinjecting a packing leak packing failure that has occurred and the packing gland has been adjusted to the fullest extent.

A. GENERAL INFORMATION

1. Determine the operating pressure, temperature, and service.
2. Determine the type of valve to be repacked (gate, globe, etc.).
3. Obtain the proper Hot Work/Safety Permits.

B. REPAIR PROCEDURE

1. Back seat the valve if possible.
2. Lubricate the eye bolts and nuts for adjustment.
3. Be certain the 1/8" NPT injector valve is tightened securely into the neck of the valve.
4. With the injector valve in an open position, complete the drill-through into the stuffing box using a 3/16" drill bit.

   A drill-through chamber **must** be used when drilling a valve containing material other than steam, BFW, and condensate in order to contain the hazardous material, or on 650# or greater.
5. Once a blow is received, retract the drill bit and close the injector valve.
6. At this time, begin the injection of the repack compound into the stuffing box.
7. Loosen the eye bolt nuts to retract the packing gland and resume pumping repack to completely fill the stuffing box.
8. Adjust the eye bolt nuts downward to compress the repack in the stuffing box.
9. Retract the packing gland again and resume pumping repack compound until the stuffing box is full and the packing gland is fully extended. (It may take more than two cycles to complete the repack properly.)
10. Close the injector valve and disconnect the injection/pump gun.
11. Tag the injector valve with a job completion listing the compound used and the date of the repair.

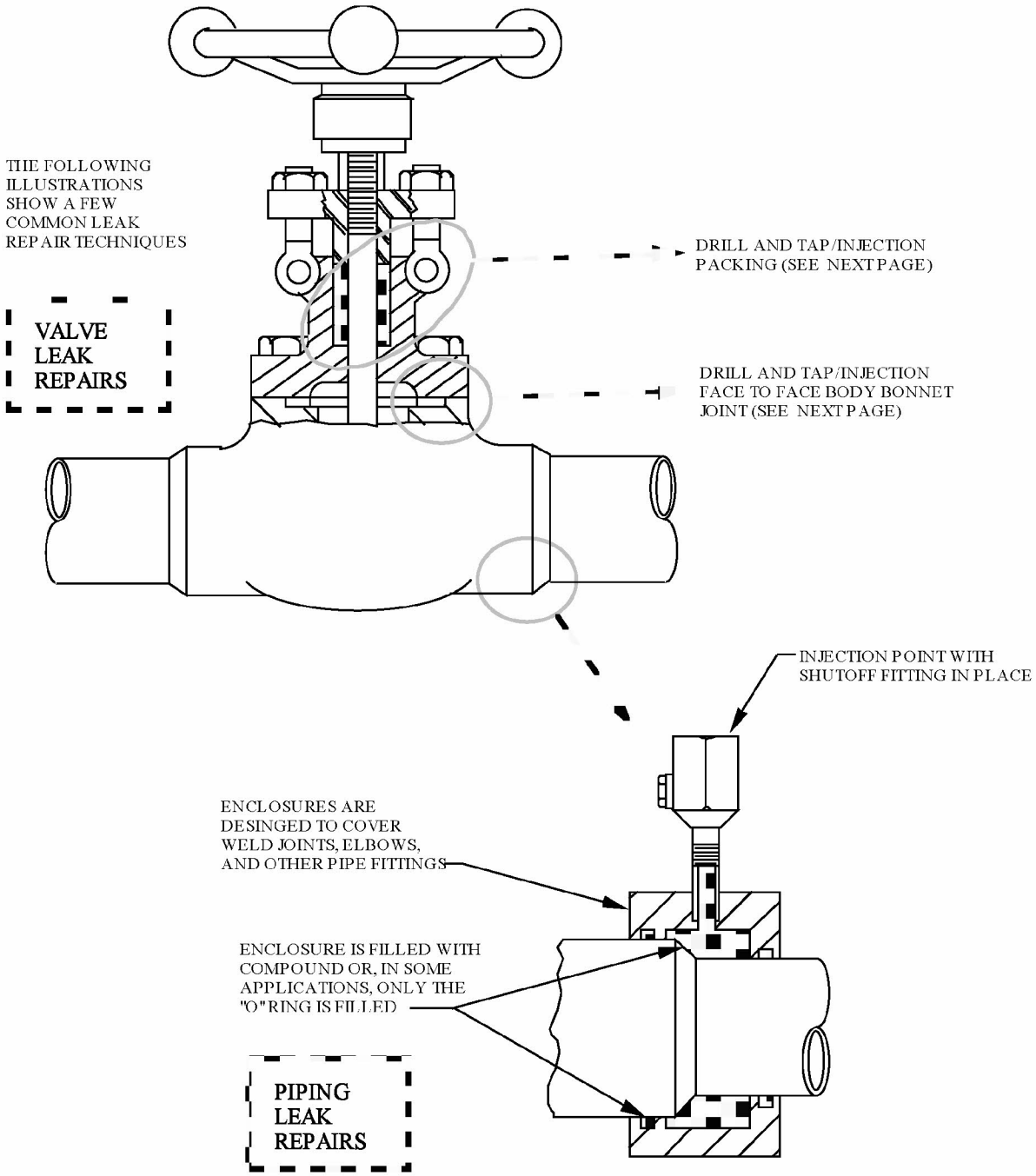
TYPE III

RICHMOND REFINERY INSTRUCTIONS

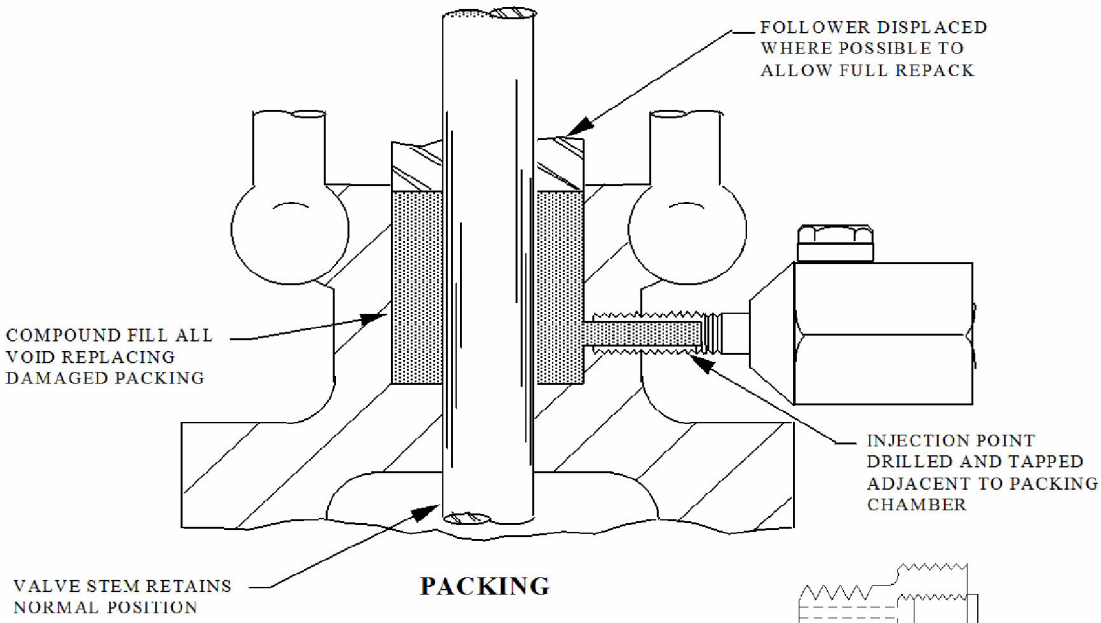
EQUIPMENT INSPECTIONS, MAINTENANCE, PROCEDURES

APPENDIX III
ON-LINE LEAK REPAIR/LEAK SEAL

ILLUSTRATIONS OF COMMON LEAK REPAIR TECHNIQUES

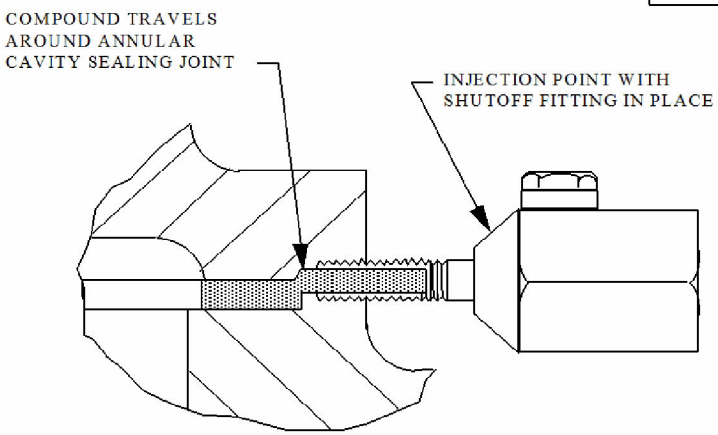


ILLUSTRATIONS OF COMMON LEAK REPAIR TECHNIQUES



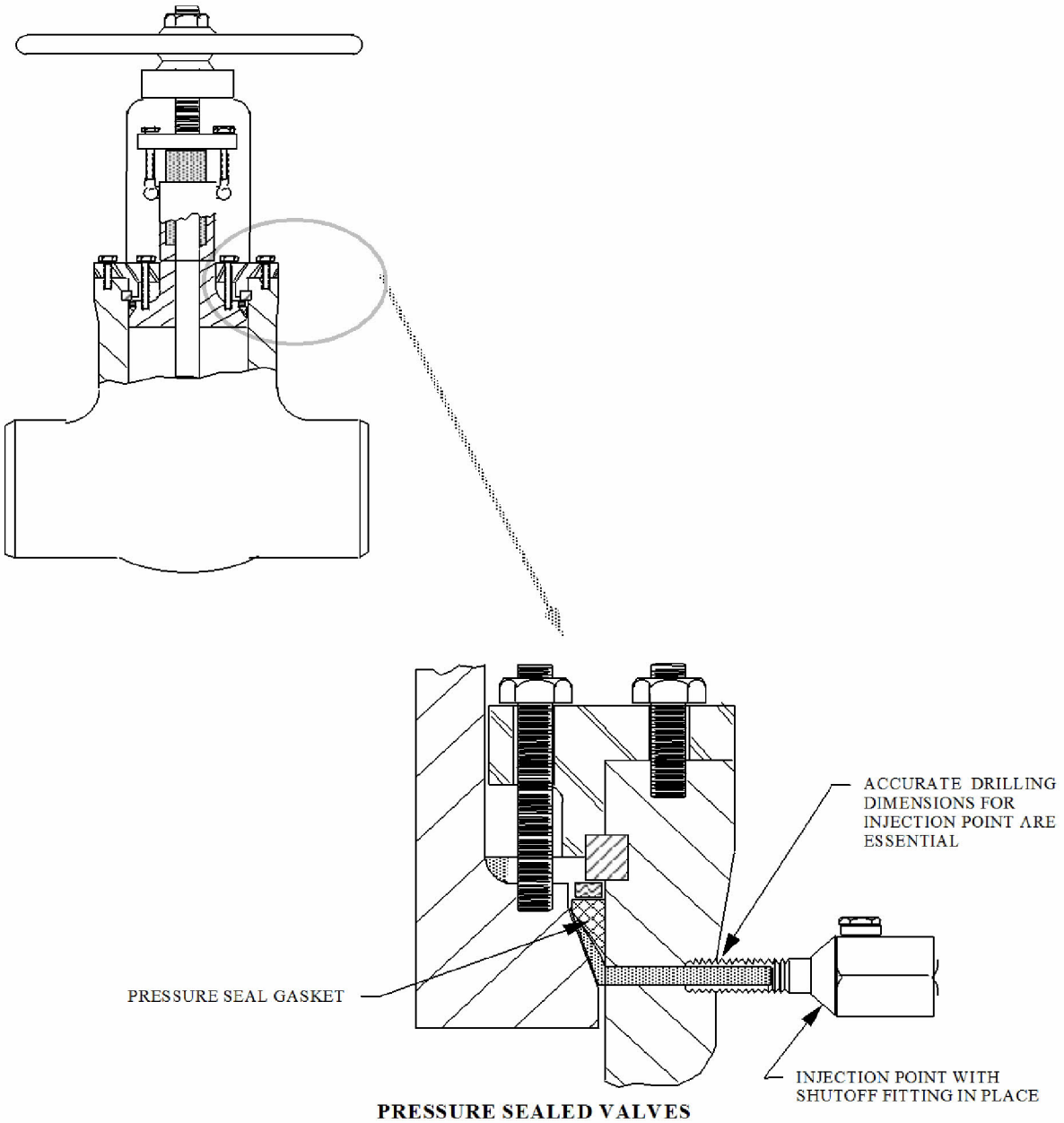
PACKING

Alternate Style Injector



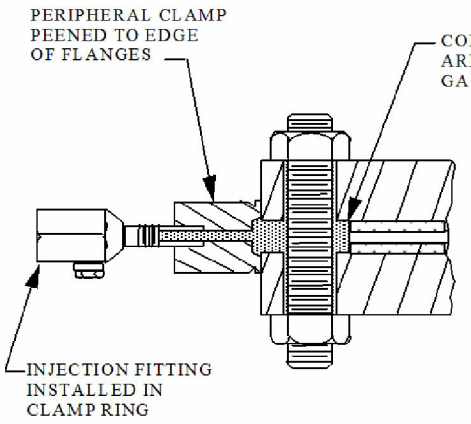
FACE TO FACE BODY BONNET JOINT

ILLUSTRATIONS OF COMMON LEAK REPAIR TECHNIQUES

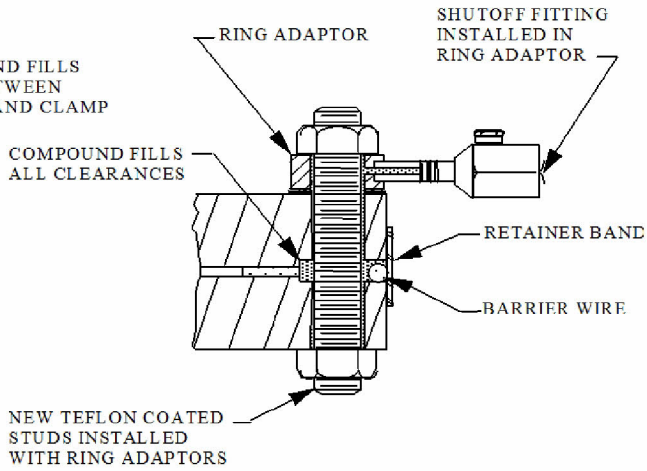


PRESSURE SEALED VALVES

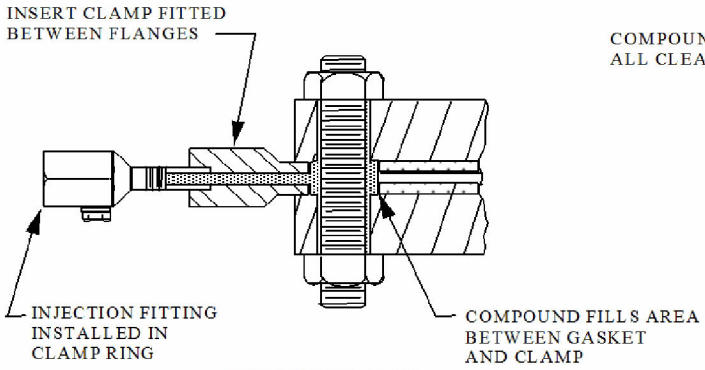
ILLUSTRATIONS OF COMMON LEAK REPAIR TECHNIQUES



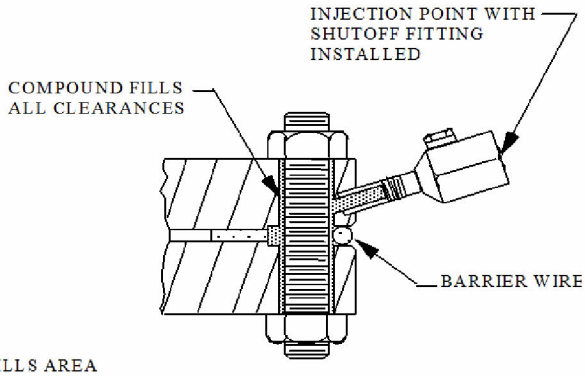
PERIPHERAL CLAMP



BARRIER WIRE WITH PERIPHERAL BAND



INSERT CLAMP

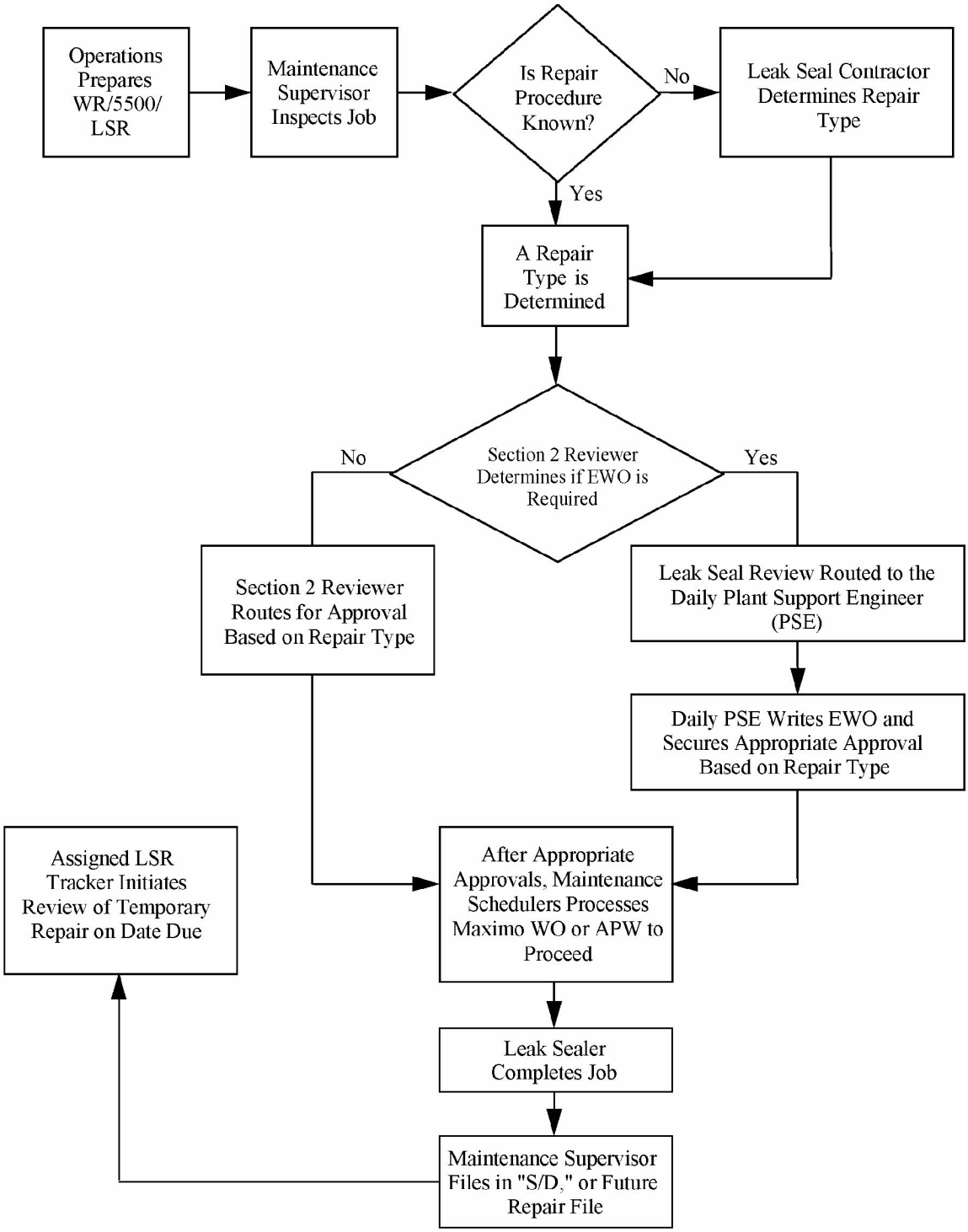


BARRIER WIRE WITH PERIPHERAL PEENING

CONTRACTOR LEAK SEAL PROCEDURES

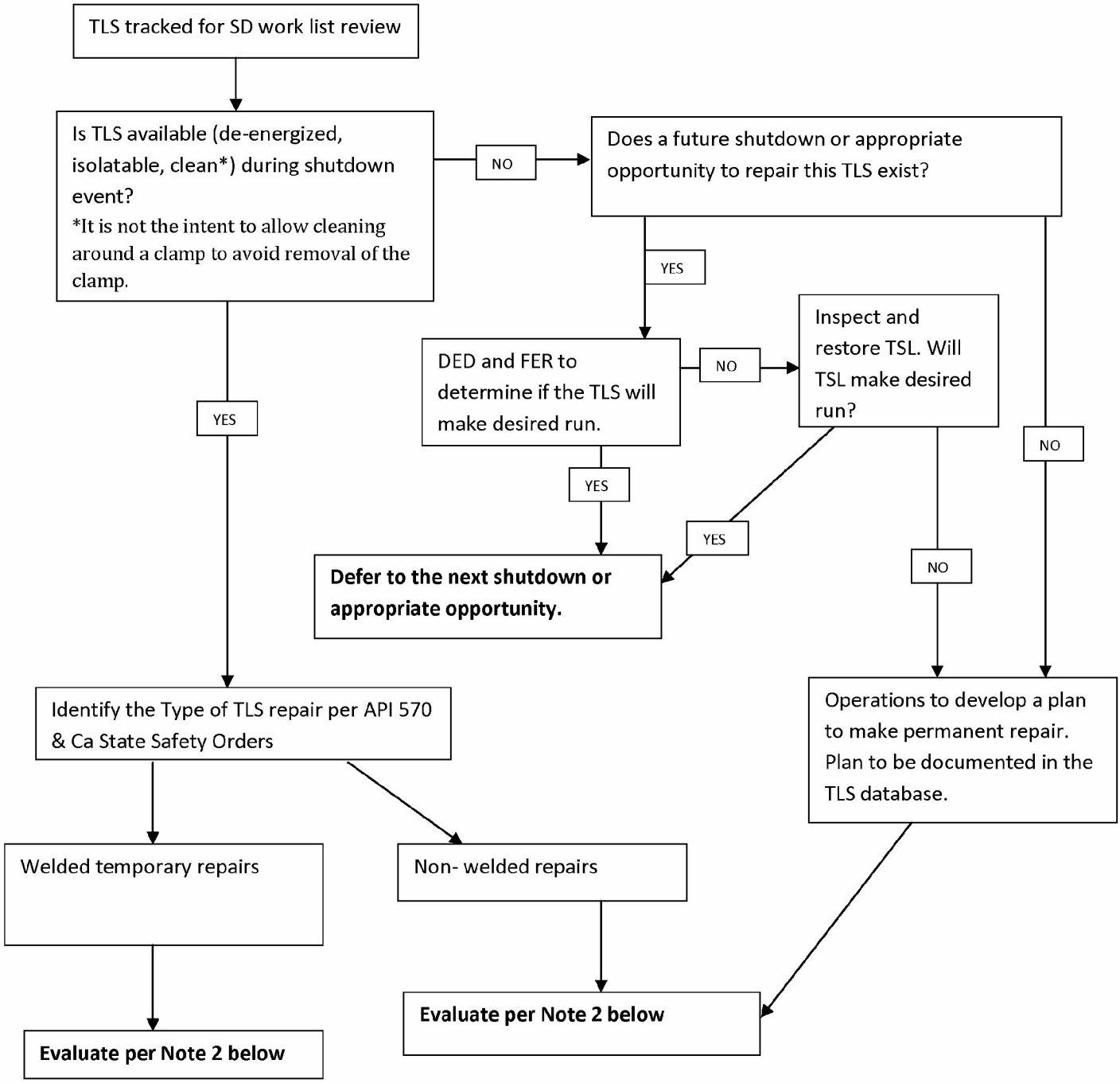
Contractor leak seal procedures are available at:

"O" drive/ERG/Public/Leak_Seal_Procedures/TEAM Procedures.


Operations Prepares WR/5500/ LSR
Maintenance Supervisor Inspects Job
Is Repair Procedure Known?
No
Leak Seal Contractor Determines Repair Type
Yes
A Repair Type is Determined
Section 2 Reviewer Determines if EWO is Required
No
Yes
Section 2 Reviewer Routes for Approval Based on Repair Type
Leak Seal Review Routed to the Daily Plant Support Engineer (PSE)
Daily PSE Writes EWO and Secures Appropriate Approval Based on Repair Type
Assigned LSR Tracker Initiates Review of Temporary Repair on Date Due
After Appropriate Approvals, Maintenance Schedulers Processes Maximo WO or APW to Proceed
Leak Sealer Completes Job
Maintenance Supervisor Files in "S/D," or Future Repair File

*LEAK SEAL REPAIR METHODOLOGY

Simplified Flow Chart of how IMPACT Core Teams address Temporary Leak Seals TLS's



*LEAK SEAL REPAIR METHODOLOGY

Simplified explanation of how the IMPACT Core Teams will address LSR's.

The following statements reflect I&R's understanding of API 570 and the California State Safety Orders.

1. Temporary Leak Seals on ASME Section1& Section 8 equipment and B31.1 piping are non-discretionary work list items. State acceptance is required to deviate from performing permanent repairs at the next available opportunity.

2. The following are API 570 repair categories and mitigation requirements:
   - **Welded permanent repairs**:
     a. No mitigation required.
   - **Welded temporary repairs** (e.g. full encirclement welded split sleeves or box-type enclosures designed by a piping engineer):
     a. Should be removed and next available maintenance opportunity. The term "*should*" makes welded repairs discretionary under the code. If a decision is made not to remove and perform a permanent repair the TLS shall be evaluated by a piping engineer with the assistance of the API 570 piping inspector to determine if the temporary repair is adequate to make it to the next maintenance opportunity without leaking. The new repair date shall be documented in the TLS database, and the associated risks and mitigations associated with the extension shall be documented in the HSE.
   - **Non welded repairs** (e.g., properly designed bolted leak clamps):
     a. Shall be removed and restored to original integrity during turnarounds or other appropriate opportunities. Other appropriate opportunities are interpreted to mean when the system is cleaned for work other than the removal of the non welded repair. The term "shall" makes non welded repairs non discretionary under the code and a repair plan must be developed.
   - **Exceptions to API 570 Repair categories** (excluded piping systems)
     a. Steam, condensate, water, air.
     b. Category D fluid service (non toxic, non flammable, non harmful to human tissue, $\leq$150 psi design pressure and temperatures from -20F through 366F).
     c. **Note:** The California State Safety Orders take specific exception to the exclusions above and direct us to create an inspection & testing program for these systems. TLS's installed on these systems will be evaluated for repair as discretionary items.
     d. **Note 2 for the RSC:** Although the CSSO's do not specify a repair strategy (there is no requirement to consider a repair during a specific TA or other repair opportunity) the State has given guidance that a repair strategy was intended under the orders. During the Sept 2006 Ca Petroleum Safety Order Training it was communicated that there needed to be an inspection & *maintenance* program for the API 570 excluded categories. Our recommendation after consultation with Safety is that these systems be considered as TA scope items, but managed as discretionary work.

3. Discretionary work list items are evaluated using the RTP (Reliability Threat Prioritization) Matrix to help determine the priority of repair based on likelihood and consequence of a leak.

DESIGN FOR AXIAL LOADING
ENGINEERING OF TEMPORARY LEAK REPAIR DEVICES TO WITHSTAND AXIAL LOADS

1. This guideline is intended to apply to temporary leak repair devices that provide full encirclement around the circumference of a pipe, nozzle, vessel, or other equipment, particularly when corrosion thinning or cracking exists and there is a chance for the equipment to completely separate within the leak sealing device.

2. Engineering of such temporary leak repair devices should, as a minimum, be designed to withstand axial end loads in accordance with the following criteria:

   a. Full sealing integrity of the device shall be maintained even if the piping or equipment suffers complete separation around its circumference within the repair device.

   b. The engineer shall review drawings or sketches of the affected equipment, considering the layout and operating conditions, and determine whether thermal, deadweight, bending or other loads might contribute significantly to the axial end load forces. If such factors are found to produce significant loads, then a full stress analysis including these factors shall be included in the design. As a minimum, the repair device shall be designed to withstand hydraulic end load forces.

   c. The axial loading capability of the device may be developed by welding or by mechanical means such as compression rings, retaining straps, teeth or ridges that engage the equipment surface, or by other means.

   d. The clamp design (including bolting) shall be evaluated using the applicable piping code allowable stresses, taken at the system design temperature. Materials of construction shall be listed by the applicable code, or for alternate materials, the safety margins (membrane stress allowable) shall be derived with a margin equivalent to the code practice. Combined load or stress factors shall conform to the applicable code. The coefficient of friction used to resist axial end loads developed by the system design pressure (and any Owner supplied supplemental loads) shall not exceed 0.3. All clamp types used in applications where axial end loads are assumed shall be provided with qualifying calculations.

   e. Calculations shall include the effect of local thinning on the existing equipment at the point of attachment, including both current condition and any future projected deterioration, as provided by Chevron or their representatives.

3. Engineering calculations and/or test data demonstrating that the leak repair device meets the forgoing criteria for axial load capability and sealing integrity shall be provided to Chevron for review and approval prior to the installation of the leak repair device. This information shall also be kept on file by the leak sealing contractor.